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Guidebook: 55th annual meeting, October 4-6, 1963, Providence, Rhode Island: title page, table of contents, introduction

Quinn, Alonzo W.

New England Intercollegiate Geological Conference (NEIGC)

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL CONFERENCE

G U I D E B O O K

55th Annual Meeting

October 4-6, 1963

Providence, Rhode Island

LEADERS:

Alonzo W. Quinn - Professor of Geology, Brown University

Thomas A. Mutch - Assistant Professor of Geology, Brown University

J. P. Schafer - Geologist, U. S. Geological Survey

Sam L. Agron - Professor of Geology, Rutgers University, Newark

William M. Chapple - Instructor of Geology, Brown University

Tomas G. Feininger - Graduate Student, Brown University, and Geologist, U. S. Geological Survey

Henry T. Hall - Graduate Student, Brown University

Several members of the U. S. Geological Survey were most helpful in the preparation of this guidebook.

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NEIGC MEETINGS, 1963, PROVIDENCE, RHODE ISLAND

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GUIDEBOOK - 55th Meeting

Providence, R. I., October 4-6, 1963

ERRATA:

p. 4, line 33 - Maskechugg should be Maskerchugg.
p. 17, line 13 - quarts should be quartz.
p. 21, last line- east should be west.
p. 24, line 12 - Bear sharp left should be sharp right.
p. 31,
Figure B-7a - arrows reversed.
p. 38, first
reference - Kay should be Kaye.
p. 40, 6th line
from bottom - the should be at.
p. 42,
2nd reference - from should be iron.
p. 47, 2nd line - Veavertail should be Beavertail.
p. 49, line 1 - Conncecicut should be Connecticut.

ILLUSTRATIONS

INTRODUCTION

Alonzo W. Quinn, Brown University

In planning the 1963 trips of the NEIGC the leaders decided that we should pick out those features of Rhode Island that are most different from those of other parts of New England. For that reason, the two bedrock trips on Saturday will be concerned with some aspects of the Narragansett Basin, a nearly unique major feature of New England geology. Likewise, the glacial trip of Saturday will provide an opportunity to study some glacial features in the vicinity of Point Judith that are somewhat different from the common glacial features of New England.

The Sunday trips will include a considerable variety of features, some of which are matched elsewhere in New England. However, some of these also are nearly unique in New England geology.

The Narragansett Basin occupies a place of considerable significance in southeastern New England geology. The significance lies partly in the fact that it is the largest mass of sedimentary rocks of known Pennsylvanian age in the New England area. Consequently, the character of these rocks provides the best evidence concerning the sedimentary and tectonic conditions prevailing in New England during the Pennsylvanian Period. In addition, these rocks were intensely deformed, and also metamorphosed, in the Appalachian orogeny, so that they provide evidence concerning that orogenetic episode. Still further, the plant fossils provide one of the few definite geologic ages in southeastern New England. Altogether, these rocks contain much evidence that can be used to elucidate the geologic history of this part of New England. Some of the evidence is known and has been interpreted; much is still obscure and the interpretations are yet to be made.

BRIEF VIEW OF RHODE ISLAND GEOLOGY

The Narragansett Basin rocks are the only rocks of known age in Rhode Island, but most of the other rocks can be given relative ages with respect to the Narragansett Basin rocks and to each other. Furthermore, most of the many different stratigraphic units can be gathered into several groups.

MAIN GROUPS OF ROCKS

These main groups are: (1) older(?) gneisses of north central Rhode Island, (2) the Blackstone Series of Precambrian(?) age, (3) the "Scituate Group" of central and southwestern Rhode Island, (4) the plutonic rocks of northeastern Rhode Island, (5) the Quincy granite and the East Greenwich Group of Mississippian(?) age, (6) the Pennsylvanian rocks of the Narragansett Basin, and (7) the Pennsylvanian or post-Pennsylvanian granitic rocks of southern Rhode Island.

Age Relations

Geological ages of the Rhode Island rocks have been assigned on the basis of evidence outlined below.

The rocks of the Narragansett Basin, group (6), seem rather definitely to be Pennsylvanian, on the basis of identification of plant fossils by older paleobatanists and by Knox in 1944.

The geological evidence for group (7) being Pennsylvanian or post-Pennsylvanian seems strong. The Narragansett Pier Granite intruded Pennsylvanian conglomerate and the Westerly Granite intruded the Narragansett Pier Granite. (Nichols GQ 91; Quinn, and others 1957)

The Mississippian(?) age of group (5) is based partly on the "giant conglomerate" in the Blue Hills area of Massachusetts, where boulders of the granite porphyry are contained in Pennsylvanian conglomerate of the Norfolk Basin. The evidence for the East Greenwich Group is not so clear-cut, but this group appears to be overlain unconformably by the Pennsylvanian rocks. Thus, in both places the Pennsylvanian rocks set an upper limit. The Quincy granite intruded the Esmond granite, and the Spencer Hill Volcanics of the East Greenwich Group contain boulders of the Esmond Granite. (Quinn GQ 17) The Esmond, when previously assigned to the Devonian, made a Mississippian age of group (5) almost necessary. However, this Devonian age is not now firmly established.

Group (4), plutonics of northeastern Rhode Island, seems, in part at least, to be younger than group (3) the "Scituate group". (Quinn GQ 13) However, there is no very good evidence of any large difference of age of the two groups; they may belong to the same general episode of granitic intrusion. The Esmond Granite, which is one of the youngest of both groups, is overlain unconformably by Pennsylvanian rocks at Natick, R. I. and it is older than the Quincy granite. It was also exposed to erosion before the formation of the pre-Pennsylvanian Spencer Hill Volcanics of East Greenwich. This all indicates that these plutonic rocks are at least two fairly long erosion intervals earlier than the Pennsylvanian rocks.

Definitely older than both plutonic groups, (3) and (4), is the Blackstone Series, group (2). This has been assigned a Precambrian(?) age, but the evidence is not strong. (Quinn, Ray, and Seymour GQ 1) They appear to be more metamorphosed than are the fossiliferous Cambrian rocks at Hoppin Hill in Massachusetts. The above history of the plutonic groups was preceded by the deposition and deformation of perhaps 20,000 feet of sediments and volcanics of the Blackstone Series. This suggests at latest a medial Paleozoic or an early Paleozoic age for the Blackstone Series; a Precambrian age is plausible.

Richmond (1952 - GQ 16) mapped a complex structure for the older(?) gneisses, group (1), and stated that they are unconformable beneath the Blackstone Series. The evidence is meager, but neither has any opposing evidence been discovered.

All of the above evidence is consistent with the following sequence of events: (I) older gneisses were formed and then deformed in an early orogeny, (II) Blackstone Series deposited, deformed, metamorphosed, and intruded by the two plutonic series (groups (3) and (4)), this orogeny being the Taconic or the Acadian, (III) erosion of older rocks and the formation of volcanics and plutonics of group (5), (IV) erosion of older rocks and deposition of Pennsylvanian rocks of the Narragansett Basin, and (V) deformation of Narragansett Basin rocks and intrusion of group (7), this being the Appalachian orogeny.

The few average ages based on radioactivity are:
Quinn and others, 1957; Hurley and others, 1960

Narragansett Pier and Westerly Granite	lead-alpha	234 M.Y.
	Rb-Sr	259 M.Y.
	K-Ar	240 M.Y.
Metamorphic minerals of Pennsylvanian rocks	K-Ar	250 M.Y.
	Rb-Sr	260 M.Y.
Quincy Granite and Cowesett Granite	lead-alpha	270 M.Y.
Scituate group	lead-alpha	306 M.Y.

However, the ages by radioactivity as listed above, fitted into the recent time scales, imply a fast and furious pace of geologic activity around here; everything after the Blackstone Series happened during the Pennsylvanian and the Permian periods. It appears, therefore, that either (1) the geologic evidence is faulty or (2) the ages by radioactivity do not represent the time of origin of the rocks but rather something else, such as a later metamorphism or the time during cooling when the hot, loose, mineral lattices tightened up enough to start holding their argon or other radiogenic elements.

Older(?) Gneisses

Within the Georgiaville Quadrangle, Richmond (GQ 16) described three gneissic formations as being unconformable beneath the Blackstone Series. They include quartz-feldspar gneisses, a porphyroblastic biotite gneiss, and minor amphibolite. These are, from oldest to youngest, the Nipsachuck Gneiss, the Absalona Formation, and the Woonasquatucket Formation. The exposures near the supposed unconformity are sparse, so the age relationship is not firmly established. These gneissic rocks are layered and are of complex structure. They probably originated as feldspathic sedimentary rocks and as volcanics.

Blackstone Series

The Blackstone Series, exposed along the valley of the Blackstone River, includes the Mussey Brook Schist, the Westboro Quartzite, the Sneech Pond Schist, and the Hunting Hill Greenstone. (Quinn, Ray, Seymour, GQ 1) The most abundant lithologic types are quartz mica schist, quartzite, greenstone, amphibolite, and marble. Apparently it consisted of interbedded sedimentary and volcanic rocks, perhaps as much as 20,000 feet thick.

The several masses of Blackstone Series in the northern part of the state can be identified and correlated with some assurance. In the central and southwestern part of the state, however, many masses of metamorphic rocks are completely surrounded by igneous rocks and these are correlated only tentatively.

Several patches of meta-sedimentary and meta-volcanic rocks on the east side of the Basin and near the mouth of the bay are of unknown age, except that they are older than granitic rocks which in turn are older than the Pennsylvanian rocks.

Plutonic Rocks of Central and Southwest Rhode Island, "Scituate Group"

Much of central and southwest Rhode Island is underlain by large intrusives of gneissic rocks, chiefly quartz diorite gneiss, Scituate Granite Gneiss, Hope Valley Alaskite Gneiss, Ten Rod Granite Gneiss, and several unnamed gneisses.

(Quinn GQ 13, Moore GQ 105) These appear to be largely of syntectonic relations, as is indicated by their gneissic structure. They are intrusive into the Blackstone Series, and the Scituate granite gneiss has been intruded by the Esmond Granite.

These plutonic rocks appear to represent the late stages of an orogeny that deformed and metamorphosed the Blackstone Series. The earliest members of the series have well-developed foliation, whereas the latest members are more nearly massive. The mineral composition also varies in a common systematic way, from quartz diorite early to granite or alaskite late.

Plutonic Rocks of Northeastern Rhode Island

The main plutonic rocks of northeast Rhode Island are intrusive into the Blackstone Series and the Esmond Granite has intruded the Scituate Granite Gneiss. These include several quartz diorites, the Grant Mills Granodiorite, and the Esmond Granite. (GQ 1) They are moderately large discordant intrusives. These rocks generally are less foliated than are rocks of the Scituate Group. Therefore, the northeastern plutonic rocks probably represent a later stage in an orogenic cycle, possibly the same cycle, than does the Scituate Group.

The plutonic rocks on the east side of the bay and in the Newport vicinity bear no close similarity to anything on the west side and their ages are unknown except they are older than the Pennsylvanian rocks of the Narragansett Basin and younger than the schists of Tiverton, Sakonnet, and Newport. These include the Metacom Granite Gneiss of Bristol and Tiverton, granite exposed widely from Tiverton to Sakonnet Point, and coarse porphyritic granite of Newport and Conanicut Island. They may or may not be equivalent to some of the plutonic rocks on the west side of the bay.

Mississippian(?) Plutonic-Volcanic Series

In the northeast part of Rhode Island are several bodies of riebeckite-aegirite Quincy granite and an associated granite porphyry. These are rather small intrusive bodies. (GQ 1)

In central Rhode Island, just west of East Greenwich, is a mass of volcanic rocks and intrusive rocks, the East Greenwich Group. (GQ 17) These seem to have the same relations as has the Quincy Granite. Included here are the Spencer Hill Volcanics, the Maskechugg Granite, a granite porphyry, and the Cowesett Granite.

Pennsylvanian Rocks of Narragansett Basin

The Narragansett Basin is a complex synclinal mass of Pennsylvanian sedimentary rocks, perhaps as much as 12,000 feet thick. They are almost all clastic rocks of non-marine origin. Conglomerate, sandstone, arkose, graywacke, shale, and siltstone were the chief sedimentary rocks. In addition, there were numerous coal beds and very minor lenses of limestone. A few layers of felsite and also basalt are exposed in the northwestern part of the Narragansett Basin (in Massachusetts). Most of the Pennsylvanian rocks are gray to black, but the Wamsutta Formation in the northwest is red. All of these rocks are firmly indurated and those to the south are progressively metamorphosed.

The formations included are the Pondville Conglomerate, the Wamsutta Formation, the Rhode Island Formation, and the Dighton Conglomerate.

Two small outliers of probable Pennsylvanian rocks are the North Scituate Basin and the Woonsocket Basin, both about six miles west of the Narragansett Basin.

Pennsylvanian or Post-Pennsylvanian Rocks

Younger than the Pennsylvanian rocks of the Narragansett Basin are the Narragansett Pier Granite and the Westerly Granite. These both occur in the southern part of the state, the Narragansett Pier Granite chiefly as a large mass of medium-grained red granite and the Westerly chiefly as south-dipping dikes of fine-grained gray granite (G-1 Fairbairn and others 1951). The Bradford dike is about 65 feet thick, dips 28° south, and extends for over a mile and a half. Many other dikes of the Westerly Granite are smaller and some are irregular in shape.

In addition to the above are several mafic dikes, some cutting the Westerly and some the Pennsylvanian rocks of the Narragansett Basin. A mass of gabbro in the west central part of the state appears to be unaffected by deformation, so it, too, may belong to the Pennsylvanian or post-Pennsylvanian group.

REFERENCES

This guidebook contains a list of general references and also more specific references for each trip. In addition, references to recent mapping are presented in the form of (a) an index map showing locations of quadrangles and (b) a list of quadrangle reports (mostly GQ maps) published and in preparation. These quadrangle reports resulted from a cooperative program between the U. S. Geological Survey and the R. I. Development Council (and its predecessor agencies).

GENERAL REFERENCES

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GEOLOGIC QUADRANGLE MAPS OF RHODE ISLAND

U. S. Geological Survey

in cooperation with Rhode Island Development Council

Published

U. S. Geol. Survey GQ No.	Date	Price	Bedrock	Surficial
1	1949	$0.50	Pawtucket	
2	1949	$0.50		Pawtucket
13	1951	$0.50	North Scituate	
16	1952	$1.00	Georgiaville	
17	1952	$1.00	East Greenwich	
22	1953	$1.00		Georgiaville
42	1954	$1.00	Bristol	
62	1955	$1.00		East Greenwich
70	1955	$1.00		Bristol
84	1956	$1.00		Providence
91	1956	$1.00	Narragansett Pier	
94	1956	$1.00		Crompton
105	1958	$1.00	Hope Valley	
106	1957	$1.00		Slocum
114	1959	$1.00	Slocum	
117	1959	$1.00	Carolina and Quonochontaug	
118	1959	$1.00	Providence	
136	1961	$1.00		Wickford
140	1961	$1.00		Narragansett Pier
No GQ Map, but similar map and text in U.S.G.S. Bull. 1071-1, 1960				Kingston
143	1961	$1.00		North Scituate
166	1962	$1.00		Hope Valley

Quadrangle Reports in Various Stages of Completion, July 1963

Bedrock	Surficial
Ashaway (R.I.-Conn.)	Ashaway
Chepachet	
Clayville	
Coventry Center	
Crompton	
Kingston	
Newport	
Oneco (R.I.-Conn.)	Oneco
Prudence Island	
Thompson (R.I.-Conn.)	Thompson
Tiverton	
Voluntown (R.I.-Conn.)	Voluntown
Watch Hill (R.I.-Conn.)	Watch Hill
Wickford	

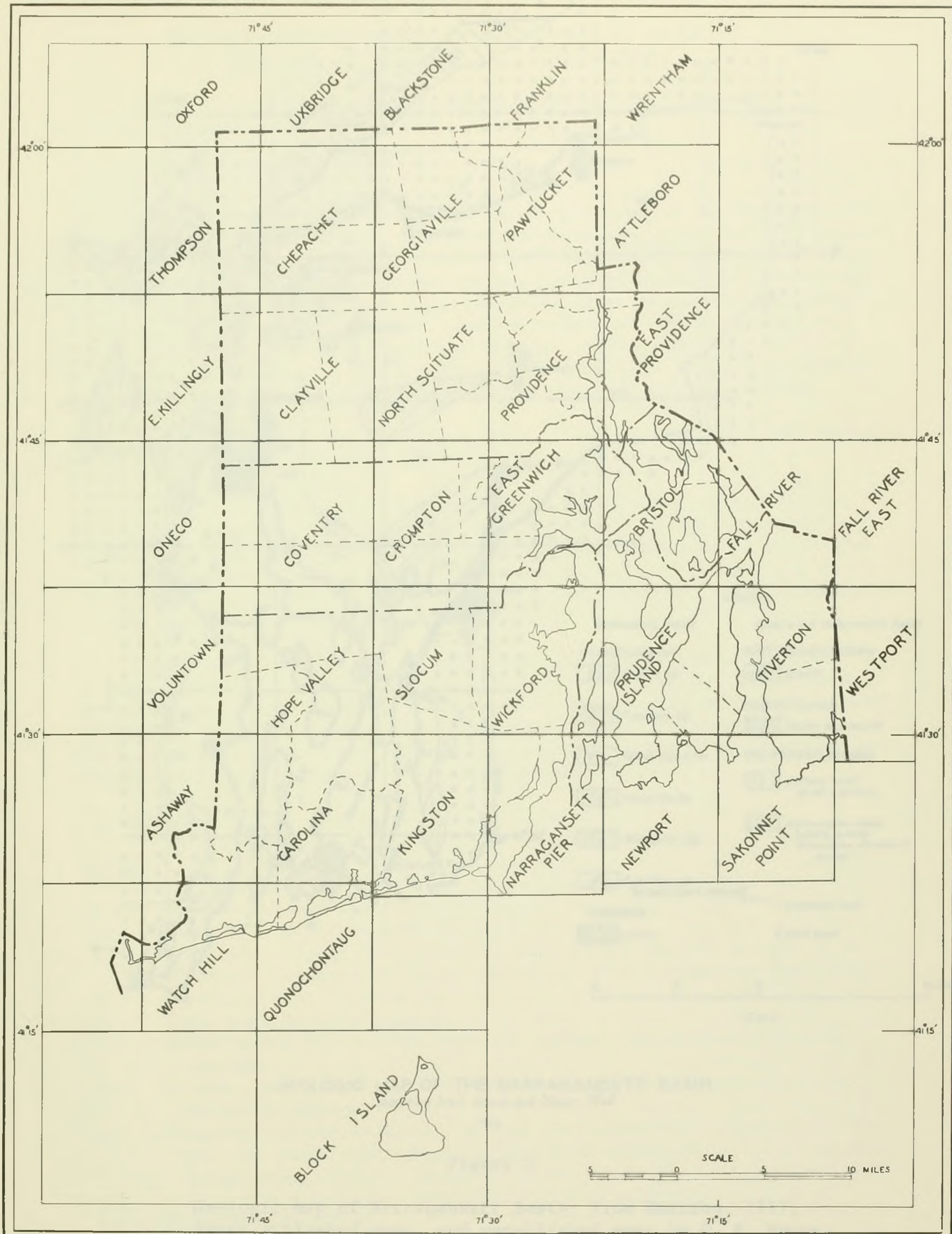
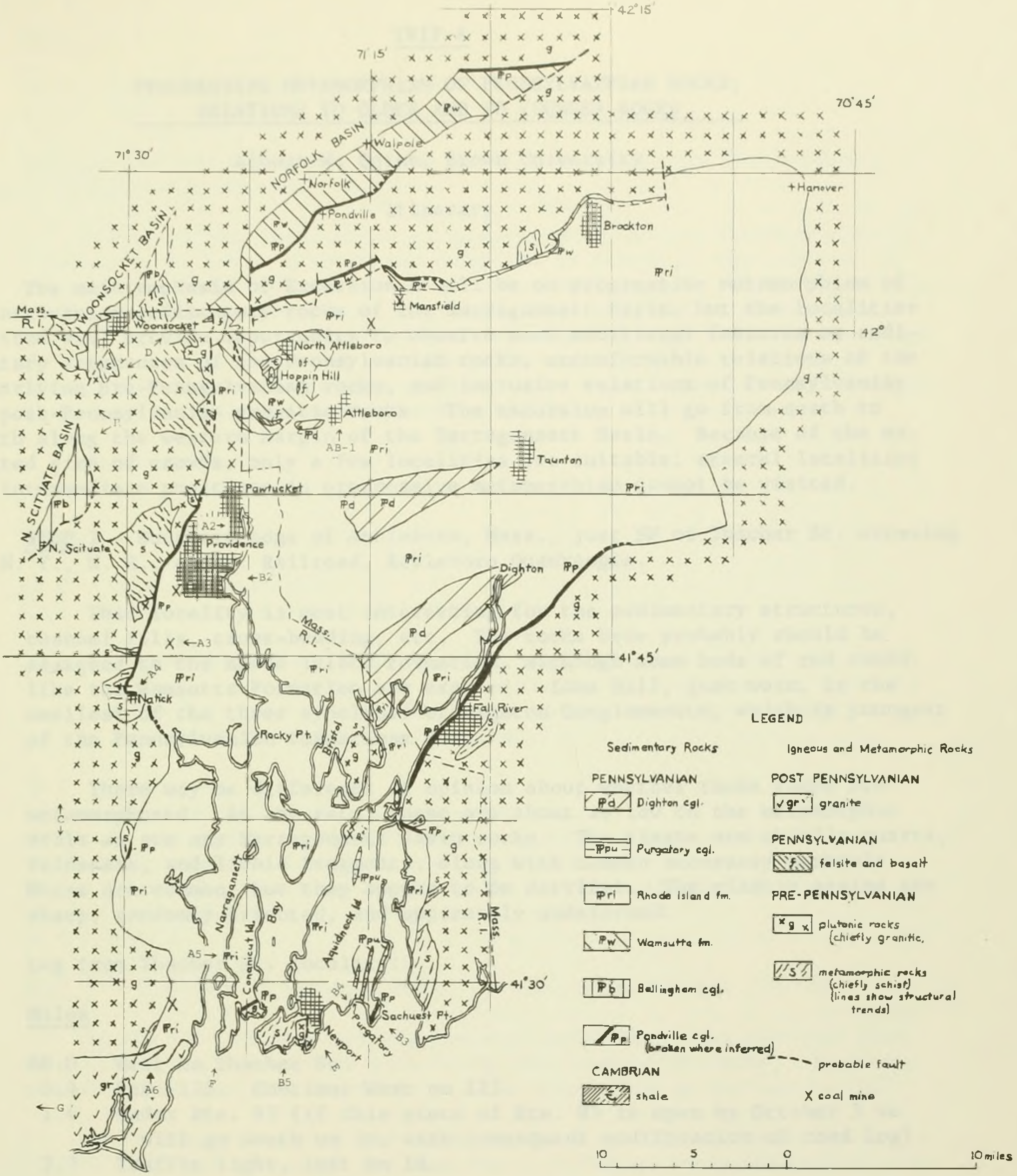


Figure 1

Index map of Rhode Island



LEGEND

Sedimentary Rocks

PENNSYLVANIAN

Pd Dighton cgl.

Ppu Purgatory cgl.

Pri Rhode Island fm.

Pw Wamsutta fm.

Pb Bellingham cgl.

Pp Pondville cgl. (broken where inferred)

CAMBRIAN

shale

Igneous and Metamorphic Rocks

POST PENNSYLVANIAN

gr granite

PENNSYLVANIAN

f felsite and basalt

PRE-PENNSYLVANIAN

g plutonic rocks (chiefly granitic)

s metamorphic rocks (chiefly schist) (lines show structural trends)

probable fault

X coal mine

10 5 0 10 miles

SCALE

GEOLOGIC MAP OF THE NARRAGANSETT BASIN

Modified from Quinn and Oliver, 1962

1963

Figure 2

Geologic map of Narragansett Basin; from Emerson, 1917, later published maps, and unpublished maps by G. E. Moore, Jr., L. J. Rusling, S. J. Pollock, G. H. Springer, and R. B. Williams.

A-2, B-2, etc. - stops or general locations of field trips.